SAM Webinar Q&A

Paul Gilman, February 8 2011

The following questions were posted as written questions during the SAM webinars on February 7 and 8.

Introduction, February 7

Hi: would it be possible to get the pwpt afterwords?
Yes. We will post a PowerPoint file of talking point on the SAM website after the sessions are over.

What is the difference between the black and the blue input variables?

Black input variables are editable, blue ones are not. SAM either calculates blue values from other input values, or displays them from other pages.

Is the financial cash flow output taking into account time value of money?
Yes, you specify a discount rate on the Financing page that represents the time value of money.

can we acutally output the simulations (i.e. the different paths & not just the average) at hourly granularity? Specifically weather input vs energy output
Yes. SAM reports the hourly simulation outputs in a number of files and formats.

Does SAM have the means to evaluate the impact of property taxes? If so, how complex/flexible is that functionality? For example, could it vary over time, or evaluate the effect of an exemption?
The property tax rate is an input on the Financing page. SAM calculates the annual property tax amount by multiplying the rate and the total installed cost value from the Costs page, and adjusting it for inflation. You can see the property tax amount in the Cash Flow table under Operating Expenses.

Can data be imported?
It is possible to import the values of input variables from Excel spreadsheets using the Excel Exchange feature (which only works in Windows). You could also use SamUL to write a script that imports values.

Can SAM give results in other values than $, for example Euro ?
No. SAM's default values are all in dollars. It may be possible to change all of the values to another currency (and ignore the dollar sign symbol), but we recommend converting values to dollars to avoid the possibility of mistakes.

Is there an option to include snow derating?
Yes. For PV systems, the Ground Reflectance variable on the Array page applies only to hours that the weather data show there is snow on the ground.

How often is the weather data updated? Is it possible to use multiple years of weather data?
For analyses that involve economic calculations over a multi-year period, we recommend using typical-year weather data. If you wanted to model the performance of a system over

several years (and have the necessary weather data), you would have to run each year as a separate case, and concatenate the results to create a multi-year data set.

Is the TMY2 and TMY3 data already included in the SAM software or does it need ot be imported?
The TMY2 data is packaged with SAM. You have to download the TMY3 data.

You mentioned that the formulas are not sent to Excel - Is there any way to copy the formulas from SAM to an Excel Spreadsheet so that sensitivity can be done in Excel?
No. SAM only exports values to Excel, not formulas.

Are there default climate inputs for international locations?
No. For international locations, the best source of data is the EnergyPlus website (see the link on SAM's climate page). You can also use the Meteonorm software and database to generate weather files for SAM, but that is not free.

What is LCOE Nominal? (I know what LCOE is)
The nominal LCOE and real LCOE are described in Help. The nominal LCOE is equivalent to what people typically describe as "LCOE." Real LCOE is used by the U.S. Department of Energy for Solar Program analysis. When comparing projects, always be sure to use the same form of the LCOE (avoid comparing real LCOE to nominal LCOE, for example).

Is it possible to get weather data for places outside the US... say Europe or Africa
Yes. You can download free weather data for non-U.S. locations from the EnergyPlus website. The link is on SAM's Climate page.

When you change the location of a system doe SAM re-orient the PV array?
No. Changing the weather file on the Climate page does not affect any other variables.

Does the programme covers only USA or can use data for other countries as wel?l
You can use SAM to model projects in any country, as long as you have a weather file and appropriate cost and financial assumptions.

Do the debt payment values in the cashflow include the interest?
Yes. SAM reports annual interest payments in the cash flow table.

How long will the DOE and NREL continue to support the SAM platfom and Version upgrages?
As long as the model continues to support DOE program goals.

Does the model include the 2011 MACRS 100% depreciation?
No, but we plan to include it in the next version.

How do you print out pages and information generated by SAM?
You cannot print directly from SAM. You can export graphs and tables by right-clicking them and copying them for use in documents.

Does the program include the value of SRECs or RECs?
You can model RECs in SAM using options on the Payment Incentives page.

Is it possible to change the currency to €? Sorry, if this question has been asked already, but I've joined the meeting just right now.
No. SAM uses the dollar symbol, and all default cost values are expressed in dollars.

How do you enter the utility TOU or rather time of production to detremin what the FIT value is
You can specify time-of-use rates, demand charges, and other complex structures on the Utility Rates page.

When calculating the LCOE both the numerator (dollars) and denominator (kWh) values are brought to year 0 with the discount factor??
Yes.

About Solar tech, can SAM simulate solar shading by near objects or by terain for example ?
For PV systems, SAM can model uniform shading of the entire array by nearby objects, but you must provide SAM with a set of shading factors to do so.

Does SAM model database has information about Regina Saskatchewan weather.
You can find weather data for many Canadian locations on the EnergyPlus website.

How does SAM model 1603 treasury grant program incentives
The Payment Incentives page has options for specifying most kinds of incentives.

Can you compare the different models for the same system (e.g. see a graph of the hourly kWh output for a PVWATTS model vs. the component-based model)?
Yes, but you have to set each system up as a different case. You cannot plot results from different technologies on a single graph.

What cost does the inflation rate apply to O & M ? insurances on system?
If you specify an O&M cost (on the Costs page) or an insurance cost on the Financing page, SAM assumes that is a Year 1 cost and uses the inflation rate on the Financing page to calculate out-year costs.

How to input a major scheduled capital expense mid way through the performance period, like replacing inverters at year 11?
You can specify an operation and maintenance cost on the System Costs page using an annual schedule, and assign costs to specific years: Click the small grey-and-blue button next to the input variable to edit the schedule.

Can you briefly explain why LCOE goes down with an increased debt percentage?
Increasing the debt percentage allows revenue from electricity sales to go toward debt payments in out years, and reduces . With a lower debt percentage, the This depends on the assumptions, but in some cases, when decreasing the year-zero investment amount by increasing the debt percentage results in a lower LCOE.

Can you add and define your own components?
To some extent, yes. For PV systems, your best bet is to use the simple efficiency model for modules or single-point efficiency model for inverters that are not in one of the component databases. SAM is not really set up to allow you to build detailed components. A simulation platform like TRNSYS would be more appropriate for that.

If you already had a PPA with a utility for ex. $0.30 kwh where would you put that input into the PV Utility to do the financial model?
To specify a PPA price as an input, use the Utility, First Year Bid Price option. To calculate the PPA price as an output, use the Utility, Independent Power Producer option. Those options are on the Technology and Market window, which you can find either by creating a new project or case, or by clicking the Select Technology and Market button at the top left of the Main window.

If i want to do a feasibility study of a grid conected parabolic trough system with a certain debt/equity to calculate the LCOE, NPV and IRR which financing option should i use, utility or commercial?
That depends on whether the project sells (and buys) power at retail rates or at a rate negotiated through a Power Purchase Agreement. For the former, use commercial. For the latter, use Utility. SAM does not calculate an IRR for commercial projects.

Can SAM provide row-to-row shading for single-axis trackers?
No. Row-to-row shading only works for fixed arrays.

Is it possible to generate a summary report including all input parameters and all main outputs, as reference for future comparison to other project variations?
SAM does not have an easy way to generate a report of all input parameters. The Case Summary workbook (Results, Case Summary, Send to Excel) lists the input variables, but does not include all of their values. You can use SAM's scripting language (SamUL) to generate reports of input variables and values, but that requires some effort and knowledge of basic computer programming.

Why the tax saving are a casflow income? Who pays that?
The current version of SAM does not separate cash flow into streams for different project partners, so all costs and income are assumed to be for a single entity.

Can you manually enter manufactures information on Panels and Inverters?
Not really, unless you use the simple efficiency model for modules or single-point efficiency model for inverters -- but those models only use a simple set of parameters. SAM does not have the capability to model modules or inverters based on manufacturer specifications. The Sandia models use data from field measurements, which are different from manufacturer specifications.

Please explain your MPPT-High and MPPT-Low categories.
Those are parameters from the Sandia inverter database. They are the manufacturer-specified maximum and minimum DC operating voltages, respectively.

AC output is about 15-20% lower than DC nameplate capacity. Why does SAM give a warning when the inverter AC capacity is lower than the DC nameplate capacity of the modules?
SAM makes some calculations before and after running simulations to try to help you make sure your inverter bank and array are properly sized. The warnings are not based on nameplate capacity ratings, but rather on either nameplate module and inverter voltage limits in the case of pre-simulation warnings, or simulated hourly power levels in the case of post-simulation warnings. or Without seeing your file and the specific warning, I can't tell what the message you see is about. But, if your system is designed as you intend it to be, you can ignore the message. You can read more about the warning messages on the Help topic for the Array page under "About Array Sizing Error Messages."

Does SAM de-rate PV for temperature?
Yes. All of the options for modeling PV modules in SAM account for temperature effects on module output.

How do you upload a weather file for a new location?
The steps are described in the Climate page's help topic. Basically, you download the weather file to a folder on your computer, add the folder to the list of weather files folders by clicking Add/Remove on the Climate page, click Refresh on the Climate page, and then find the file in the Location list on the Climate page.

Why for a commercial project (independant electricity producer), LCOE is calculated as revenue / generation, but not cost / generation?
This is a convention that has been adopted by some analysts.

How long will the DOE and NREL continue to support the SAM platfom and Version upgrages? I am using version 2010.4.12. I see you have version 2010,11,9 I have tried to upgrade under the help tab - but it states that I have the latest verion - which version is the latest?
As long as the model continues to support DOE program goals. You can check for updates on the Help menu, which are software changes that do not involve a change in version number like updating component databases or making changes to the Help system. To upgrade your version of SAM, you have to download a new version from the SAM website and install it to replace an older version. You can run more than one version of SAM on your computer at the same time. The current version of SAM is 2010.11.9.

If utility ipp option is chosen, where I can change the bid price if I know the PPA amount?
To specify the PPA price as an input, you must choose the Utility Market, First Year Bid Price financing option from the Technology and Market window. The Utility Market, Independent Power Producer option calculates the PPA price as a result when you specify a target minimum IRR and other constraints.

If there is a fixed long term avoided cost credit rate (per kwh) associated with a PPA rate, can SAM account for that?
Not directly. You may be able to account for it by specifying an incentive on the Payment Incentives as a proxy for it.

Can you fix the limits of the trackers movements degree?
No, not for PV systems. SAM assumes that the trackers can follow the full movement of the sun throughout the day.

How is the ITC cash grant accounted for in the model?
You can specify the amount of a cash grant on the Incentive Payments page, and also specify whether or not the grant is taxable.

Does this model have weather data for other countries?
You can download free weather files for some locations outside the U.S. from the EnergyPlus website. The Meteonorm software and database is another source of weather data for non-U.S. locations, but is not free.

If i want to do a feasibility study of a grid conected parabolic trough system with a certain debt/equity to calculate the LCOE, NPV and IRR which financing option should i use, utility or commercial?
The Utility financing option is appropriate for most parabolic trough systems, which are for power generation projects. For a small roof mounted system that displaces a building's electric load and sells excess electricity to a utility, the commercial option would be appropriate.

Advanced Modeling, February 8

Are you able to output the raw data for the hourly values through Dview? E.g. for Collector_DNI_cos_theta? Thanks!
Yes, you can export hourly values from DView. To do so, in DView, click the Hourly tab and check the names of each variable you want to export. Then click the "zoom to show all data button" at the bottom of the widow just to the right of the zoom in and out buttons. Finally, right-click the graph and choose Export Data.

Back to single-axis PV: Does SAM assume a single row, or does it assume multiple rows? If multiple rows, what row spacing is assumed? In other words, does SAM use "Packing Factor" or other control to establish spacing? Bottom line, does SAM take inter-row self shading into consideration?
If you enable the self-shading calculator on the Shading page, then SAM will account for row-to-row shading of the array. You must specify an array layout on the Shading page that is consistent with the layout specified on the Array page. See the shading help topic for more details.

Can you link more than 2 parametric variables?
Yes.

Can you overwrite climate data from an excel sheet? e.g. Can you multiply the DNI values in the climate data with a constant and use excel exchange to overwrite it?
No. There is no way to modify the data in a weather file during simulations. The only way to modify weather data for use in SAM is to make changes to the weather file.

Can you use Python/MATLAB/etc code to have SAM run parametrics/optimizations? Also, can you ask SAM to generate a sub-year (down to only one hour/timestep) simulation from the programming languages?
SAM's code generator only includes inputs for the base case (those that you see on the input pages) in the code it generates, so you cannot control parametric simulations in SAM from your code. However, you could write your own optimization algorithm in your code, and use it to set values of input variables used in simulations as part of the optimization. When you run a simulation from your code, SAM runs an hourly simulation for one year.

Cool stuff. -Ground coverage ratio (GCR) variable available? Efficiency adjusted cost vs LCOE?
SAM's Land Area variables on the Array page (for PV systems) are something like a ground-coverage ratio. SAM just reports the land required by the system based on the array area and the packing factor you specify -- it does not make any cost adjustments based on the land area. SAM's LCOE calculation is based on the results of an hourly simulation that accounts for the system's hourly conversion efficiency. Costs are based on nameplate capacity ratings.

For Azimuth by Altitude, can the user specify this data in higher resolution, i.e. in 1 degree increments?
Yes. On the Shading page (for PV systems), the azimuth-by-altitude option for entering shading factors allows you to use a table at any resolution by changing the number of rows and columns in the table.

I have noticed that the discount rate is not the same as the WACC. Usually I understand the discount rate for a DCF analysis to be set equal to the WACC - am I just wrong about this, or what is the standard that SAM follows? I also don't see a number for "cost of equity." I usually consider this to be part of what determines WACC. Without being able to set a cost of equity, how is WACC computed?
The discount rate is an input value in SAM, so you can set it to be the same as the WACC if you want. The WACC equation is described in the Array page's Help topic.

Have the heat losses from the HCEs libraries been validated against test results? specifically the Schott PTR 70 2008?
The heat loss parameters for the Schott PTR 70 2008 HCE are based on the work described in the NREL publication: Burkholder and Kutcher, Heat Loss Testing of Schott's 2008 PTR70 Parabolic Trough Receiver, which you can download at http://www.nrel.gov/csp/troughnet/pdfs/45633.pdf.

How can a parametric simulation be created using Excel Exchange to input variables from a workbook for each case? You mentioned it could be done but it wasn't obvious how.
It is not possible to pass more than one value from Excel to a SAM variable specified as a parametric variable. The best way to automate a parametric analysis would be to write a script using SamUL to read values from a CSV file.

Is it common to have this type of load data? WHo do you get it from
The hourly load data required by SAM for residential and commercial systems with demand charges or tiered rates specified on the Utility Rates page is not easy to come by. SAM includes a set of sample files generated for some U.S. cities that you can access from the Electric Load page. Some electric utilities provide hourly load profiles for a geographic area that might provide an indication of usage patterns. Retail customers with time-of-use rates sometimes have access to hourly data as part of their agreement with the utility. Otherwise, you can make estimates of daily profiles by month based on appliances and electrical equipment in a building and rough estimates of the hours per day that they will be used.

Is it possible to capture/send variables from different tabs in the spreadsheet or does it always read in the first tab?
No. SAM looks at the first worksheet in the workbook.

Is it possible to import a table of linked variables and values into your parametric simulation setup?
The best way to work with tables of data is to write a script in SamUL to import them.

Is the temp/depth databse limited to the US?
Yes, the resource database for the Geothermal model is limited to the U.S.

Is there a detailed manual on how SAM estimate power block performance using different cooling systems?
Yes, for the physical trough model, there is a draft manual that explains the model in detail at http://dl.dropbox.com/u/6651433/PhysicalTroughTechManual_DRAFT_10-2010.pdf.

Our company uses its own performance calculation software for conventionell power plants. Is it possible to use own power block calculation results in sam (own efficiency curves)?
Not very easily (for the physical trough model) because SAM determines when collectors defocus and dispatches energy from the solar field and storage based in part on the power block capacity. SAM does report the intermediate hourly thermal output from the solar field and to the power block that you could use as input to your power block model, but that might not result in an accurate representation of how the system would perform.

The variables sent to excel are used in the spreadsheet but the value is not kept in the excel?
That's correct. When you use Excel Exchange, SAM opens a copy of the Excel file in the background during simulations and then closes it when the simulations are finished. It does not save any data to the Excel file.

What is the maximum no. of variables that can me modify at once by the parametric analysis?
There is no limit to the number of variables you can specify as parametric variables, but you should not specify too many variables or simulations will take too long and results will be too complicated to interpret. Most parametric analyses involve fewer than four or five variables.

When adding a parametric simulation and then going to the tabular data browser, can you see the multiple results side by side?
Yes. To see parametric results in the Tabular Data Browser, choose the "Parametric Set" option in the Choose Simulation list.

When creating tmy3 file, how can I create a clomun for wind direction?
SAM's solar models ignore the wind direction variable. SAM's built-in TMY3 Creator does not have a column for wind direction. If you want to modify the wind direction data, you can do it by modifying the file directly in Excel or another program that can read comma-separated text files.